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CONTENTS

QUARTERLY

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EDITORIAL

IT IS WRITTEN

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To begin with the formation of the radiologist's opinion, the common practice in radiology and in pathology is to examine the films or the histologic sections only after appreciating what the clinical problem is. Park[1], in discussing the histologic diagnosis of cancer, states that "This, in my view, is the least profitable and the least accurate way of assessing a section. Foreknowledge of the clinical data introduces into our minds a quite ineradicable bias — a bias such that some degree of prejudgment of the section is almost impossible to avoid". The same argument may, with considerable justification, be advanced for the method of the radiologist. If he knows, in the average case, what the clinical problem is before he looks at the film or the fluoroscope, he is in many instances misled into making a clinical or semi-clinical diagnosis which he then "reads into" the radiologic evidence. The alternative method is to examine as carefully as possible the radiologic evidence first, to form an initial impression, and then to review it in the light of the clinical evidence. This approach has the merit of increasing objectivity, though complete objectivity is of course never possible. It diminishes the number of times the radiologist is led into [illegible]d false diagnoses by preformed impressions, and it perhaps increases the possibility th[illegible] observe changes on the film or the screen which might otherwise escape his notice, wer[illegible] pre-occupied with a preliminary diagnosis.

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J. S. DUNBAR, M.D.

1. Park, W. Wallace; Lancet; vol. 1; 701; 1956.
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ACUTE PNEUMOCOCCAL LOBAR PNEUMONIA: THE SIGNIFICANCE OF NON-SEGMENTAL DISTRIBUTION*

by
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and
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Montreal

A thorough familiarity with the segmental anatomy of the lungs has always been an important part of a radiologist's store of knowledge. In recent years surgical resection of individual pulmonary segments for various diseases has made such knowledge a necessity, since exact description of pulmonary anatomy may be of inestimable value to the thoracic surgeon. There has arisen a tendency for radiologists to attempt to relate all localized pulmonary diseases to the bronchus leading to the area of lung involved, thereby creating the connotation that the abnormality is in essence segmental. We submit that this practise may be subject to considerable error and can, on occasion, give rise to an incorrect radiological interpretation of a pathological process. Many sub-lobar opacities of infectious origin such as those produced by acute pneumococcal pneumonia are non-segmental and therefore should not be ascribed to a specific bronchial distribution. Although this fact has been stressed by Dornhorst and Pierce[8] and has long been recognized by other authors[6,12,22], it receives scant attention in standard textbooks of radiological diagnosis[5,14,23], and possibly is applied less often than is warranted as a useful adjunct in the radiological differential diagnosis of infectious diseases of the chest.

A brief review of the experimental investigation of the mechanism by which such changes are produced is presented as a foundation for discussion.

For many years the concepts of Blake and Cecil regarding the pathogenesis of acute pneumococcal pneumonia, originally put forward in 1920[2], were accepted without serious opposition. It was their contention that pneumococci penetrated the epithelium of the main bronchus of the lobe near the hilum and spread rapidly by way of perivascular and peribronchial tissues and lymphatics to the alveolar septa at the periphery of the lung, where they passed into the alveoli along with the inflammatory exudate. Some doubt was cast on this concept in 1933 by Robertson and his co-workers[19,20,24] who demonstrated experimentally in dogs that the spread of pneumococcal pneumonia within a lobe was by progressive extension of the inflammatory exudate circumferentially from lobule to lobule *without obvious relationship to bronchial segments.* Subsequently, the mechanisms by which local spread occurs once the organisms reach the lung periphery were further clarified by Loosli. In 1937[15] this worker reported the presence and nature of interalveolar communications in normal and in pathologic mammalian lungs, establishing to a most convincing degree that such communications do exist, and supporting his assertions by photomicrographs and camera lucida drawings that leave little doubt as to the validity of his conclusions (Fig. 1). Among the experimental methods he used was the intratracheal injection of fluid containing Type I Pneumococci, with the subsequent demonstration of oedema fluid and fibrin strands passing in continuity from alveolus to alveolus through the pores of Kohn (Fig. 2). Later he confirmed the conclusions previously reached by Robertson regarding local spread of the inflammatory exudate, and added many new observations of his own[16]. In all animals studied, consolidation began at the periphery of the lung and progressed toward the hilum. A sharp line of demarcation constantly existed between the advancing front of consolidated parenchyma and the unaffected lung contiguous to it, no matter at what stage of development of the lesion the animals were sacrificed (Fig. 3). Maximum consolidation occurred uniformly at 22 hours. Initially the exudate consisted of oedema fluid containing a few red blood cells, leucocytes and pneumococci. Extension of the lesion occurred chiefly by direct dissemination of bacteria-laden oedema fluid from alveolus to alveolus through interalveolar pores, although aspiration of exudate from bronchiole to bronchiole also played a part in spread. Progressive in-

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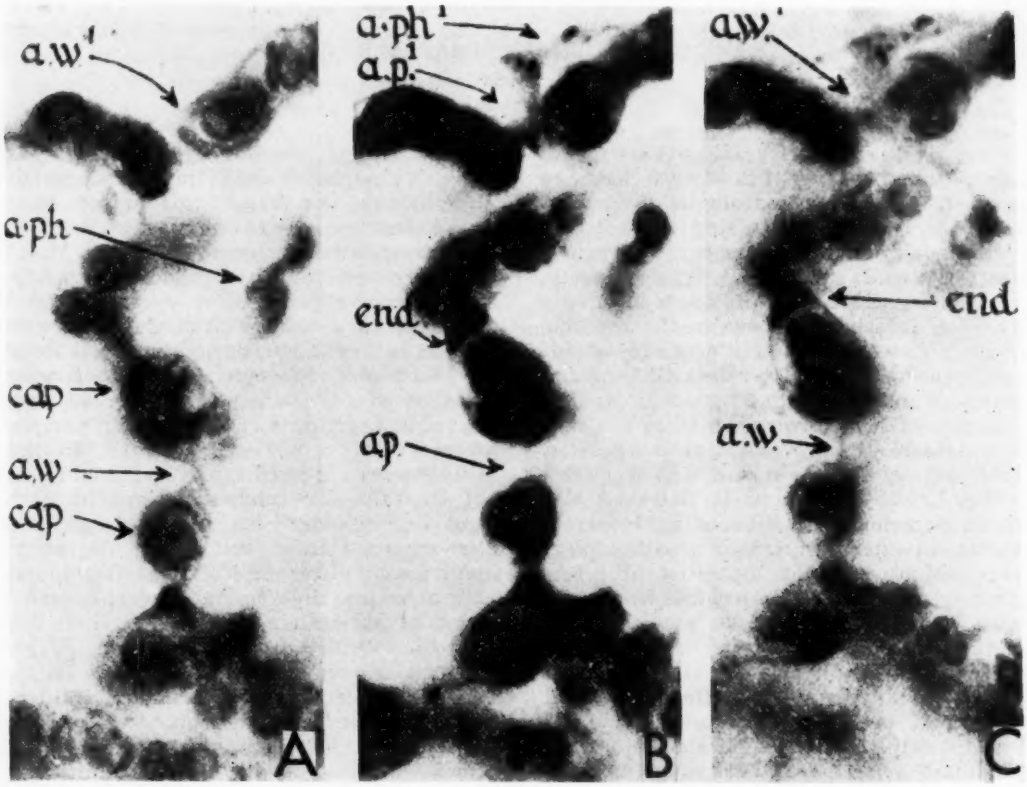
volvement of lung parenchyma was thus circumferential from the point of inoculation. Because of intrabronchial inoculation the lesion was initially of segmental bronchial distribution but such relationship rapidly disappeared (Fig. 3). Still further evidence against the peribronchial dissemination of fluid exudate, the sequence of spread from one lobe to another depended almost entirely on the anatomical arrangement of the bronchi in relation to the position in which the animal was placed. These facts suggested that secondary dissemination of pneumonia was the result of a relatively fluid inflammatory



Figures 1, (a), (b), and (c). Photomicrographs of a normal alveolar wall of a dog's lung made at three different planes of focus. (a), the upper plane. Here the alveolar wall at points a.w. and a.w.[1] is intact. (b) the middle plane. Two complete interruptions in the alveolar walls are shown at a.p. and a.p.[1]. These are alveolar pores, one of which (a.p.[1]) contains a free pigment-filled alveolar phagocyte (a-ph.[1]). (c), the lower plane. The lower portion of the walls (a.w. and a.w.[1]) of the alveolar pores which are seen in (b) are shown. Ten micron sections; hematoxylin stain; magnification x 1000.
Figure and legend by courtesy of Clayton G. Loosli, M.D. and A.M.A. Archives of Pathology, 1937, 24, 743.

pneumococci was the relative absence of bacteria in the perialveolar spaces compared to the large numbers within the alveoli.

While these investigations clearly established the mode of dissemination of the infection, a group of ingenious experiments carried out by Robertson and his co-workers clarified the route by which the pneumococci reached the alveoli[13,21]. In 1940 these workers demonstrated that the dissemination of pneumococcal pneumonia in dogs from one lobe to another depended largely on the viscosity of the exudate, the more fluid the exudate the greater the likelihood of spread. Even more significant was their observation that, given a exudate *flowing under the influence of gravity into the most dependent bronchi and alveoli.*

These observations were later confirmed by Robertson[18] who was able to induce pneumonia at will in any pre-selected lobe of a dog by injecting fluid pneumonic exudate intra-bronchially and intra-tracheally and varying the position of the animal so that the exudate would be carried by gravity into the desired lobe via the most dependent bronchus. If the position of the animal was such as to favour flow away from the peripheral bronchial tree and towards the glottis, pneumonia did not result. These observations

provided perhaps the most decisive piece of evidence that the pathogenesis of pneumococcal pneumonia does not lie with the penetration of organisms through the bronchial wall and thence peripherally, but with the propensity for the inflammatory exudate to flow distally under the influence of gravity via the intrabronchial route.

To summarize, the pathogenesis of experimental acute pneumococcal pneumonia embodies the following:

1. An inhaled fluid laden with bacteria, passes under the influence of gravity into the most dependent bronchus of the tracheobronchial tree at that moment, and thence via the intrabronchial route to the alveoli of one or more lobules at the periphery of the lung[18].

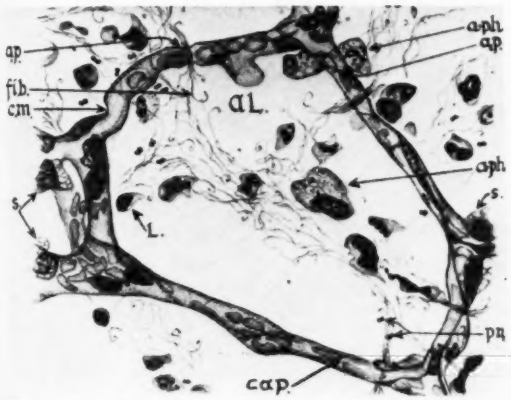


Figure 2. A camera lucida drawing of a thinly sectioned (10 microns) lung of a dog infected intratracheally with Type I pneumococci and killed after 2½ hours. The drawing represents the margin of a lesion where the alveoli contained fibrin (fib.) strands connecting through pores (a.p.) in the alveolar walls as well as a few inflammatory cells.
Hematoxylin-eosin-azure II; Bausch and Lomb 2 mm. objective and x 10 ocular; camera lucida at stage level.
Figure and legend by courtesy of Clayton G. Loosli, M.D. and A.M.A. Archives of Pathology, 1937, 24, 743.

2. An acute inflammatory reaction is set up, characterized by the rapid out-pouring of oedema fluid into the alveoli of the lobules involved. At this early stage the disease is necessarily segmental since its inception has been via the intrabronchial route.

3. The inflammation is rapidly disseminated circumferentially from the initial alveolar lesions, largely via interalveolar communications (pores of Kohn). *The relationship with bronchial segment promptly disappears.*

4. The consolidation characteristically begins at the periphery of the lung at the site of infection and progresses toward the hilum, a sharp line of demarcation generally existing between the advancing front of consolidated parenchyma and unaffected lung contiguous to it.

General Considerations

It is reasonably safe to assume that, in humans, the inflammatory reaction in the lungs to the diplococcus pneumoniae differs in no fundamental respect from that described in the experimental animal. Similarly, there is abundant evidence to suggest that any acute pulmonary infection in which the reaction is predominantly one of alveolar fluid exudate will manifest similar pathological and radiological characteristics, and such is

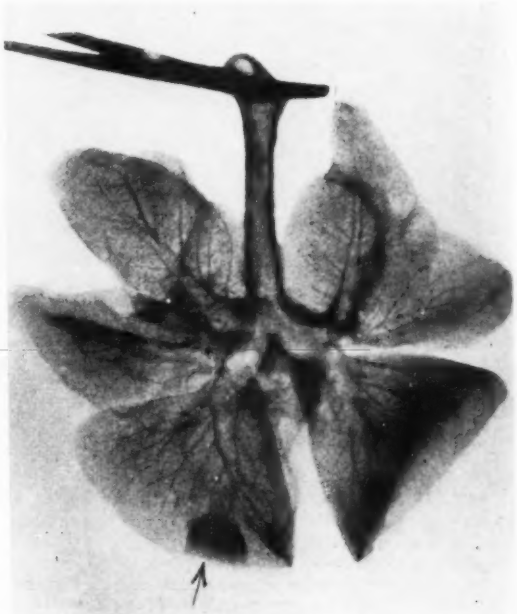


Figure 3. Radiograph of the excised lungs of a dog, removed 1 hour after injection of 0.5 cc. Pneumococcus Type I culture. This early lesion is still situated within the confines of the segment into which the culture was injected, but its rounded margin indicates circumferential spread and suggests that the inflammation will soon extend beyond the segmental boundary.
Figure by courtesy of Robertson, O.H., Coggeshall, L.T. and Terrell, E.E.: and J. Clin. Invest. 1933, 12, 467.

the case in acute Friedlander's pneumonia[9,17], acute tuberculous pneumonia and the early stages of "Q" fever[10].

Thus, there exists a group of diseases whose pathogenesis involves the out-pouring of an alveolar exudate which is disseminated rapidly in a circumferential manner so as to promptly lose any bronchial relationship.

Compare with these a somewhat larger group of pulmonary affections, exemplified by streptococcal and staphylococcal bronchopneumonia and by primary atypical pneumonia, which are characterized by a predominant peribronchial or interstitial inflammation of the lung. In these, while alveolar exudation may play a part in the pathological process, involvement of the bronchial and bronchiolar walls and the peribronchial, perilobular and perialveolar interstitial tissue creates a mainly segmental distribution especially when the often associated bronchial and bronchiolar obstruction by mucus plugs leads to segmental atelectasis[1,7].

Despite the important differences in the pathogenesis of these two groups of pulmonary infections, the dissimilarity in their anatomical distribution has been largely ignored by many radiologists. When confronted with chest films revealing a sub-lobar opacity of infectious origin, a tendency exists to suggest two possible explanations: first, that the density has a specific bronchial distribution; then, if this fails, that an atypical bronchial supply be postulated to explain the peculiar distribution. Nowhere is this latter attitude more frequently resorted to than in the axillary portion of the lungs, particularly in the upper lobes. This attitude is exemplified in a recent paper by di Guglielmo and Bonomo[11], who explain the axillary localization of pneumonia on the basis of atypical bronchial distribution as described in the many treatises on bronchial anatomy, particularly those of Brock[4] and of Boyden and Scannell[3]. They maintain that axillary lung zone involvement can be accounted for either on the basis of an autonomous axillary bronchus arising from the upper lobe bronchus (Fig. 4c), variously reported by different authors as occurring in 10 to 18 per cent of upper lobes[11], or on the basis of the anterior or more commonly the posterior segmental bronchus having in its distribution a much larger portion of the axillary region of the lung than usual (Fig. 4a). They do not enter-

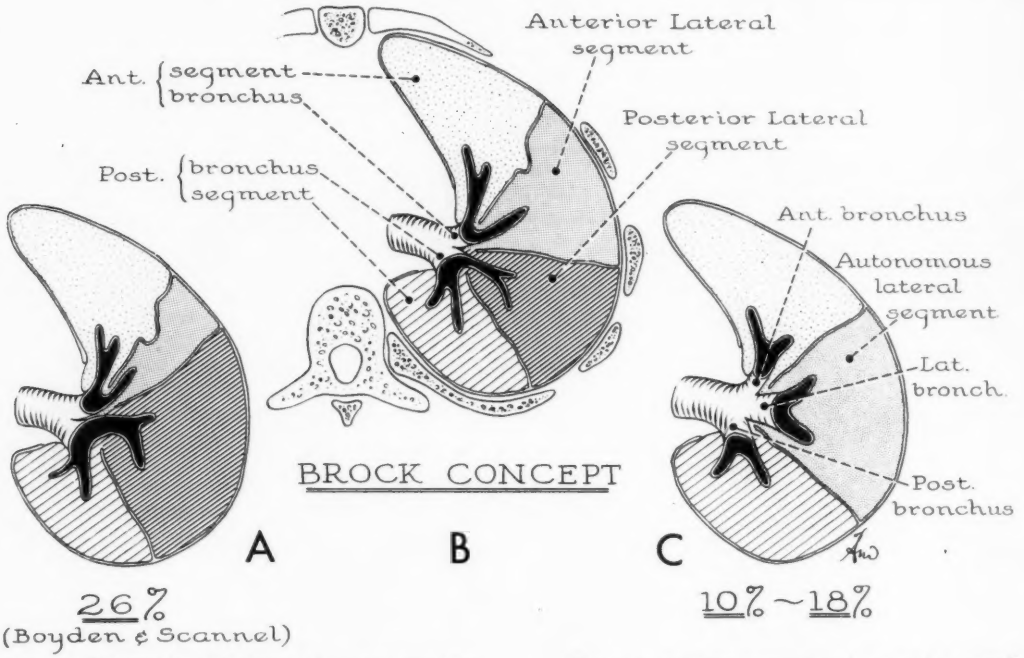


Figure 4. Schematic drawings of cross sections of right upper lobes showing different arrangements of "axillary" bronchial segments:

a. Either the posterior or less commonly the anterior segmental bronchus provides an axillary branch which occupies a proportionately large area of the axilla, the resulting segment "straddling" the horizontal and chief fissures. Formed 26 per cent of 50 lobes dissected by Boyden and Scannell.

b. The most frequent arrangement whereby anterior and posterior segmental bronchi contribute an axillary branch each of which supplies an approximately equal portion of the axillary zone.

c. The whole axillary is supplied by an 'autonomous' bronchus, there thus being four separate bronchial divisions of the right upper lobe bronchus. Variously reported with a frequency of 10 - 18 per cent.

Modified from Brock, R.C., "The Anatomy of the Bronchial Tree," 2nd Edition, Oxford Univ. Press, 1954.

tain the possibility of an alternative to these explanations and, in fact, remark on the difficulty in understanding "how two or more 'areas' of different segments can be simultaneously diseased while the remaining parts of the segments to which they belong are left undamaged"! It is our contention that indictment of unusual bronchial distributions does not have to be resorted to in the majority of cases showing axillary consolidation. While certain diseases of true segmental distribution, such as obstructive pneumonitis or bronchopneumonia, will occasionally show a distribution in the upper lobes

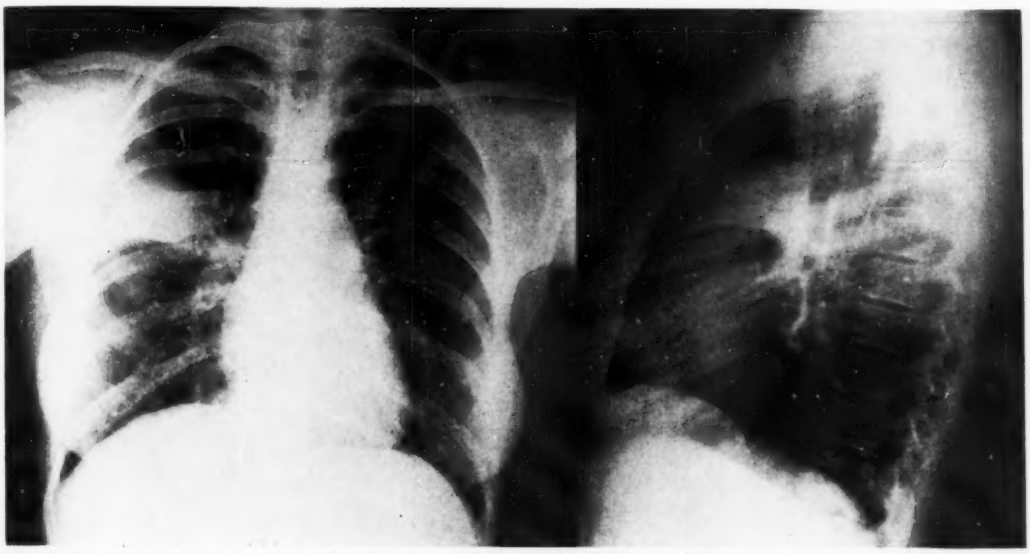


Figure 5. Consolidation of the "axillary" portion of the right upper lobe. Note localization to the inferior portion of the lobe and straddling of the fissures. This and all other patients whose films are reproduced showed a heavy growth of *Diplococcus pneumoniae* in their sputa.

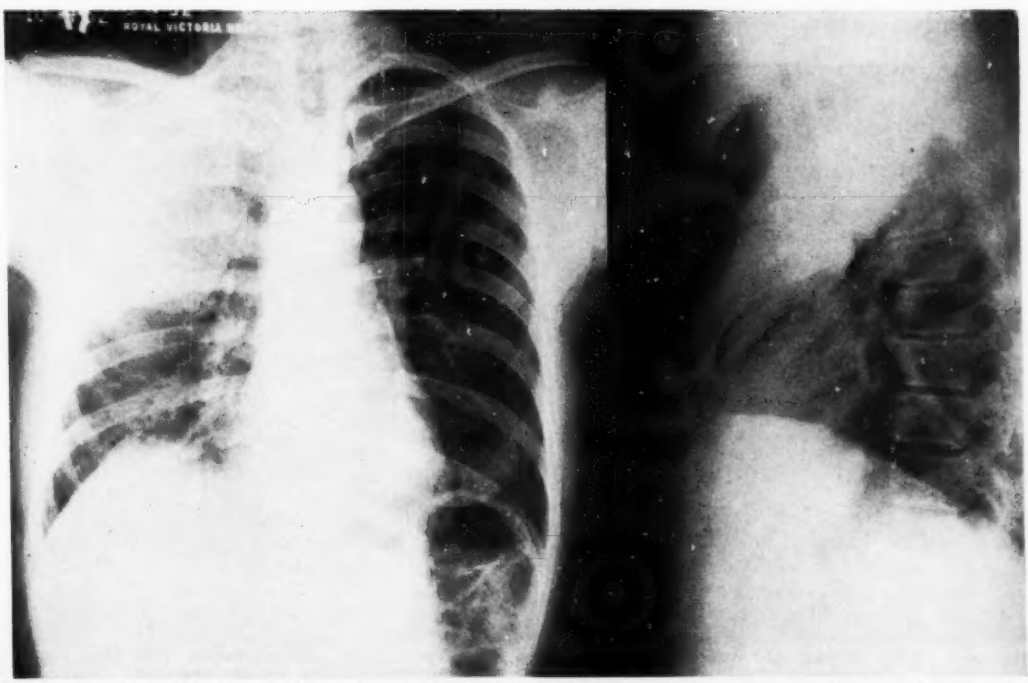


Figure 6. Consolidation of the entire right upper lobe, excluding only the anterior portion projected 3 or 4 cms. posterior to the sternum. Compare with Figure 9.

in which the horizontal and oblique fissures are "straddled" due to aberrations in bronchial distribution, the majority of densities occupying these areas can be explained more simply and more physiologically on the basis of circumferential dissemination of alveolar exudate showing no respect for segmental boundaries within lobes. That interalveolar communications exist not only between lobules but between major intralobar segments was amply demonstrated physiologically by Van Allen and Lindskog in 1931[25], and it is because of these communications that the dissemination of virulent pneumococcal or Friedlander's pneumonia is able to occur so rapidly through an entire lobe.

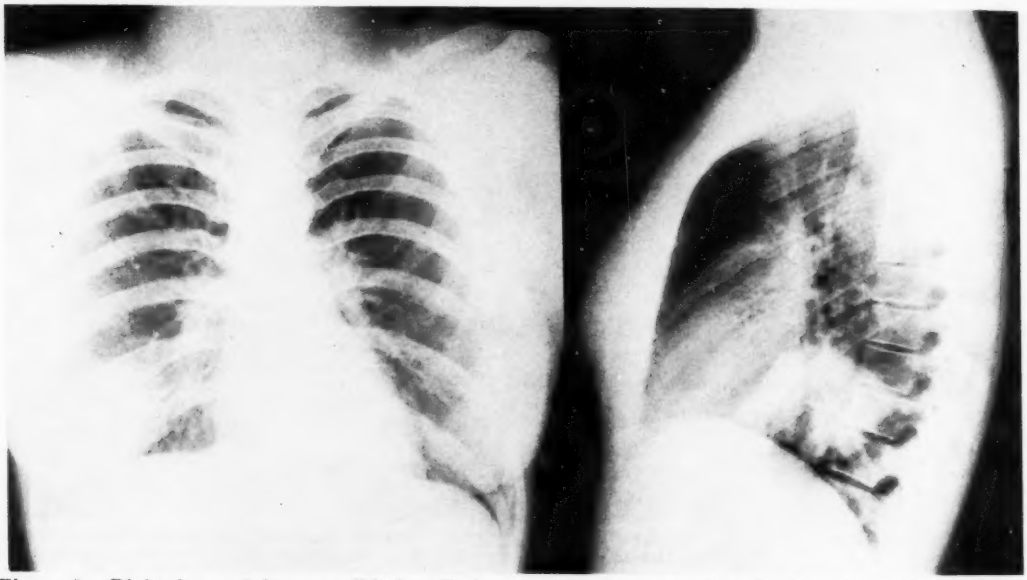


Figure 7. Right lower lobe consolidation fitting no definite segmental distribution. The consolidation abutts against the chief fissure anteriorly, but elsewhere the sharply delineated somewhat rounded contour suggests circumferential spread.

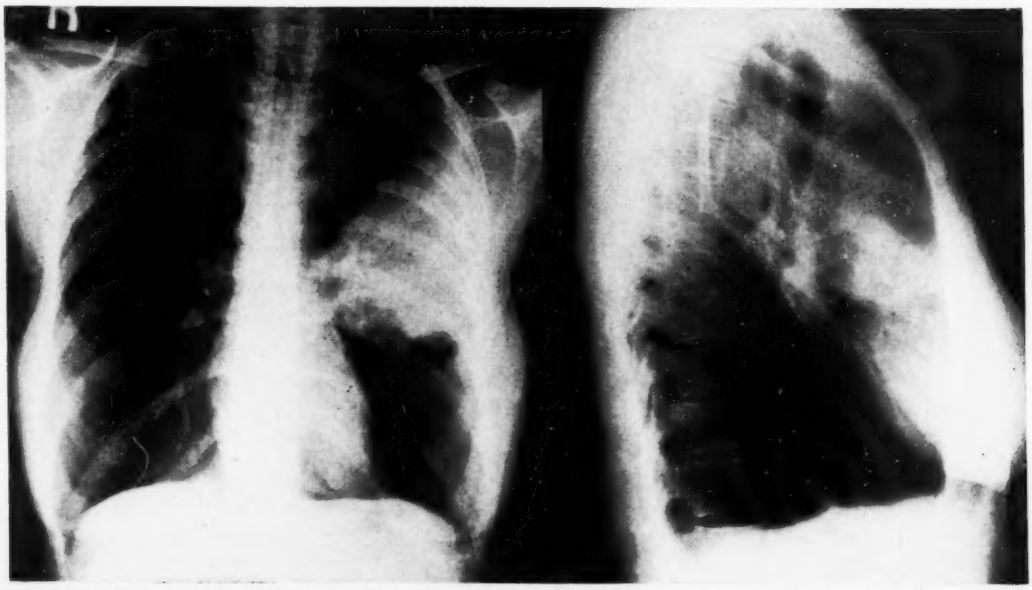


Figure 8. This 39 year old woman had fractured the tenth and eleventh right ribs ten days previously and had subsequently suffered less pain lying on her left side. The axillary position of the pneumonic consolidation indicates the influence of gravity on the bronchial flow of the bacteria-laden fluid that caused the pneumonia.

A review of the radiological characteristics of fifty-six unselected cases of proven pneumococcal pneumonia seen in the Royal Victoria Hospital in the past five years has lent much support to the experimental observations of Loosli and of Robertson. (Table I). Of these fifty-six cases, a total of forty-nine (87 per cent) showed consolidation which involved less than a complete lobe, and of these, forty-four were non-segmental in distribution and revealed other characteristics on which we felt a diagnosis of a pneumococcal etiology could be made with considerable certainty. Compare with these figures those of an unselected and admittedly smaller group of sixteen cases of Staphylococcus and Streptococcus pneumonia, of which eight were sub-lobar in extent and *all* of these of true segmental distribution.

TABLE I.

56 Cases of Acute Pneumococcal Pneumonia

Complete Lobar Consolidation .. 7

Sub-Lobar Consolidation 49 (87%)

44 Non-segmental — 5 Segmental

16 Cases Staphylococcus or Streptococcus Pneumonia

Complete Lobar Consolidation .. 8

Sub-Lobar Consolidation 8

0 Non-segmental — 8 Segmental

With some variation due to the specific lobes involved, the following alterations were observed with a high degree of consistency in the forty-four cases of sub-lobar pneumococcal pneumonia. While individually many of these are well recognized radiological features of lobar pneumonia, taken as a group they reveal a pattern which sets this disease apart from other acute respiratory infections.

1. The consolidation is peripheral in situation and often, but not invariably, abutts against a fissure along some part of its margin (Figs. 5 and 6).

2. Its contour is generally round, except where it abutts against a fissure, a reflection of circumferential spread (Fig. 7).

3. Its margins are sharply defined, even those borders which do not lie contiguous to a pleural surface (Fig. 7).

4. The increase in density is homogeneous, reflecting the involvement of all alveoli by progressive outward dissemination of the infection from the point of inoculation. A frequently observed "air bronchogram" is the only blemish to absolute homogeneity.

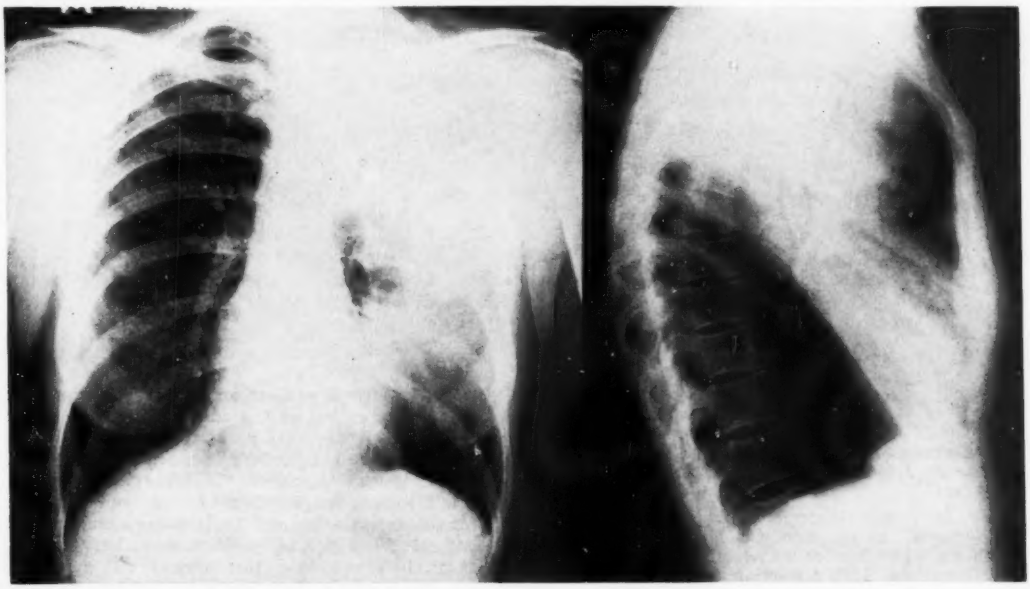


Figure 9. Almost complete consolidation of the left upper lobe, the only area not involved being in the anterior retrosternal region. Note, however, that the uninvolved portion of lung is not localized to the total distribution of the anterior segmental bronchus.

5. There is little or no loss of volume, indicating the absence of associated bronchial obstruction.

6. The distribution of consolidation within a lobe frequently reflects the influence of gravity on the intrabronchial flow of

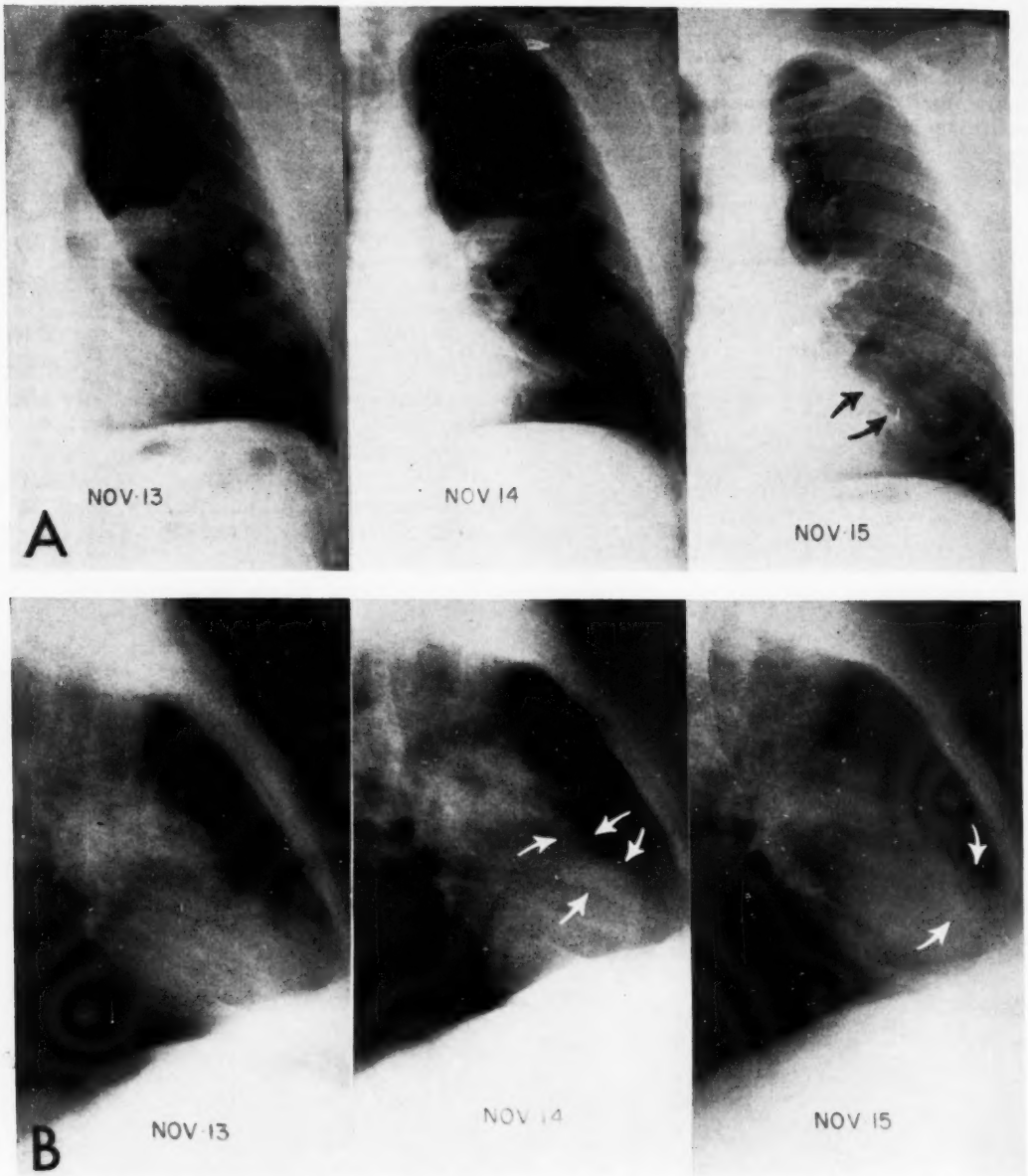


Figure 10. Serial roentgenograms of the chest of a 39 year old man admitted to hospital November 13th within 24 hours of the onset of symptoms of an acute respiratory infection. Sputum culture produced a heavy growth of *Diplococcus pneumoniae:*

a. In postero-anterior projection, the lesion is "central" in location. On November 13th and 14th the heart border was fairly sharply defined; by November 15th a portion of the heart border had become obscured by a density contiguous to it (arrows), suggesting involvement of a portion of the lingula. By December 1st almost complete clearing had occurred.

b. In lateral projection, the density is seen to occupy a portion of the anterior segment of the upper lobe, presumably related inferiorly to the intersegmental boundary between the anterior and lingular segments. On November 14th, a small tongue-shaped density was seen to be extending inferiorly into the lingular area, and this had increased in size by November 15th (arrows). It is believed that this represents peripheral extension of the inflammatory exudate across a segmental boundary via interalveolar communications. Note the absence of any relationship of the lingular density to the hilum.

bacteria-laden aspirate (Fig. 8). For example, it is common for the inferior portion of the right upper lobe to be affected; rare for the apical portion (Fig. 5). One particularly thought-provoking observation has been that in none of our cases of upper lobe pneumonia has there been involvement of the anterior portion of the lobe (projected 3 or 4 centimeters retrosternally) despite total consolidation of the remainder of the lobe (Figs. 6 and 9). No completely satisfactory explanation can be suggested for this strange distribution, although it appears to be peculiar to alveolar pneumonia since the retrosternal area has been observed to be consolidated in several cases of staphylococcal bronchopneumonia and of obstructive pneumonitis.

Discussion

In these days of prompt and efficient antibiotic therapy of acute respiratory diseases, there would appear to be little gained from the early radiological diagnosis of acute pneumococcal pneumonia. From a practical point of view this is at least partly true. However, when the diagnosis can be made — and experience has shown that this is possible with considerable accuracy — what is gained is the advantage of prompt institution of specific therapy against the diplococcus pneumoniae rather than broad antibiotic coverage against an organism of unknown type. But perhaps an equally important consideration lies in the differential diagnosis. With the

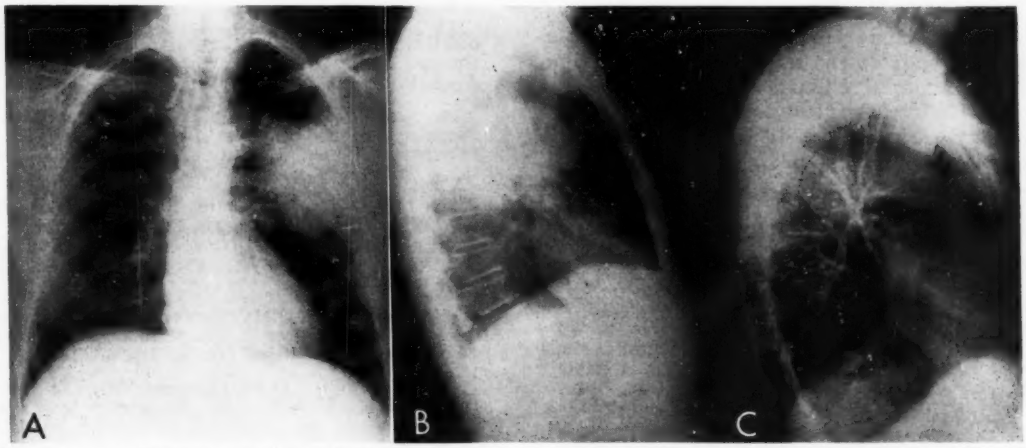


Figure 11. a) Postero-anterior and b) lateral roentgenograms of the chest show a sharply circumscribed somewhat rounded consolidation of the axillary portion of the left upper lobe, of proven pneumococcal etiology. The round shape suggests centrifugal spread.

c) is a lateral projection of a bronchogram performed two weeks later because of slow resolution of the pneumonia. The two lateral views were superimposed and the original area of consolidation marked out in grease pencil on the bronchogram. It will be seen that the original area of involvement included portions of both the apicoposterior and anterior bronchial segments and did not have a distribution which could be attributed to the whole of either of these segments, or to an autonomous bronchus.

7. Peripheral spread across segmental boundaries has been assumed to have occurred in many cases on good evidence. In one patient, five serial examinations performed at daily intervals showed the peripheral extension of a pneumonia in the anterior portion of the left upper lobe across the segmental boundary into the lingula (Figs. 10, a and b). In another case, a bronchogram was performed before complete resolution of a pneumococcal pneumonia of the central and axillary regions of the left upper lobe had occurred. Superimposition of representative films made during the exudative phase of the disease on those made at bronchography clearly demonstrate that the pneumonia crossed major intralobar segmental boundaries (Fig. 11).

real increase of lung cancer over the past few decades, the radiologist perhaps more than any other physician must maintain a high index of suspicion regarding the possible dangers lurking behind pulmonary consolidations of segmental distribution. The ability to interpret a pulmonary consolidation as one of alveolar exudation of non-segmental distribution as compared to obstructive pneumonitis of bronchial origin is obviously a big step toward accomplishment of this most important differential diagnosis.

Summary and Conclusions

1. Certain acute infectious diseases of the lungs, epitomized by pneumococcal lobar pneumonia, are characterized pathologically

by alveolar exudation without appreciable interstitial involvement. Although the pathogenesis includes the passage of infected material within the bronchial lumen to the lung periphery, dissemination then takes place circumferentially via interalveolar communications, so that relationship to bronchial segments rapidly disappears. The result, radiologically, is an area of parenchymal consolidation which is anatomically non-segmental in distribution.

2. In contrast, there exists a group of pulmonary affections, exemplified by bronchopneumonia and obstructive pneumonitis, in which involvement of the bronchus and peribronchial and interstitial tissues creates X-ray densities which are localized to specific bronchial segments.

3. The importance of a correct radiological analysis of the non-segmental distribution of acute pulmonary infections lies not only with one's ability to suggest the correct etiology early in the disease so that appropriate therapy may be instituted, but with differentiation from diseases of true segmental distribution, such as obstructive pneumonitis, in which a high index of suspicion plays such a vital role in early diagnosis.

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ON THE USE OF BI-AXIAL ROTATION THERAPY WITH COBALT^{60}, PHYSICAL BASIS AND APPLICATION IN THE TREATMENT OF CARCINOMA OF THE CERVIX*

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The combination of intracavitary radium-therapy and external radiation therapy has been the usual treatment for most cases of cancer of the cervix. Radium is the accepted therapeutic agent for the treatment of the cervix and of the para-cervical region. However, for the parametrial region and for large vaginal involvement, radium alone is insufficient and some form of complementary external radiation therapy is needed. Complementary external radiation therapy for vaginal involvement, when possible, is not without serious danger. Furthermore, the use of radium in cancer of the cervical stump, is inefficient for many cases. Therefore, the method of approach for cases with large vaginal involvement and also for cases of advanced cancer of the cervical stump, is mainly by external radiation therapy.

TABLE I

Therapeutic Value and Integral dose of isodose curves obtained in Bi-Axial Rotation Therapy with Cobalt^{60} as a function of field size and angular Rotation. —

Field Size cm.	Arc of Rotation each side Degrees	Distance between the two axes cm.	Integral Dose in Megm. R.*	Therapeutic Value of Isodose Curve
6 x 15	90	8	21.9	Not recommended
6 x 15	120	8	22.	Fair
6 x 15	150	8	24.9	Good
6 x 15	180	8	25.3	Fair
6 x 15	150	7	22.1	Fair
6 x 15	180	7	22.8	Excellent
6 x 15	210	7	23.2	Excellent
7 x 15	120	8	26.8	Fair
7 x 15	180	8	24.7	Excellent
7 x 15	210	8	25.	Excellent
7 x 15	150	7	23.	Fair
7 x 15	180	7	—	Excellent
7 x 15	210	7	—	Excellent
8 x 15	120	8	29.	Fair
8 x 15	150	8	28.3	Fair
8 x 15	180	8	26.2	Excellent
8 x 15	210	8	—	Excellent

* For 6000 r. Tumor Exposure Dose and unit density material.

The present work was undertaken in view of studying the possibilities and advantages of rotation techniques with Cobalt^{60}. It does not seem to be proven that external radiation therapy alone can cure the majority of cases of cancer of the cervix, even if given up to the limit of tolerance with the best facilities available today. However, at the

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*A contribution from the Physics Laboratory of the Montreal Cancer Institute, in Collaboration with the Department of Radiology of Notre Dame Hospital.

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"Fondation Curie", from a group of 100 patients treated by external therapy alone, at 200 Kv. and 500 Kv., between 1930 and 1945, Baclesse[1] has reported that radiosensitive lesions of the cervix are curable with roentgentherapy alone. Baclesse stated in his work, that he obtained the best results in those cases with vaginal extension.

The physical value of any radiation technique can best be assessed by studying the distribution of radiation within an appropri-

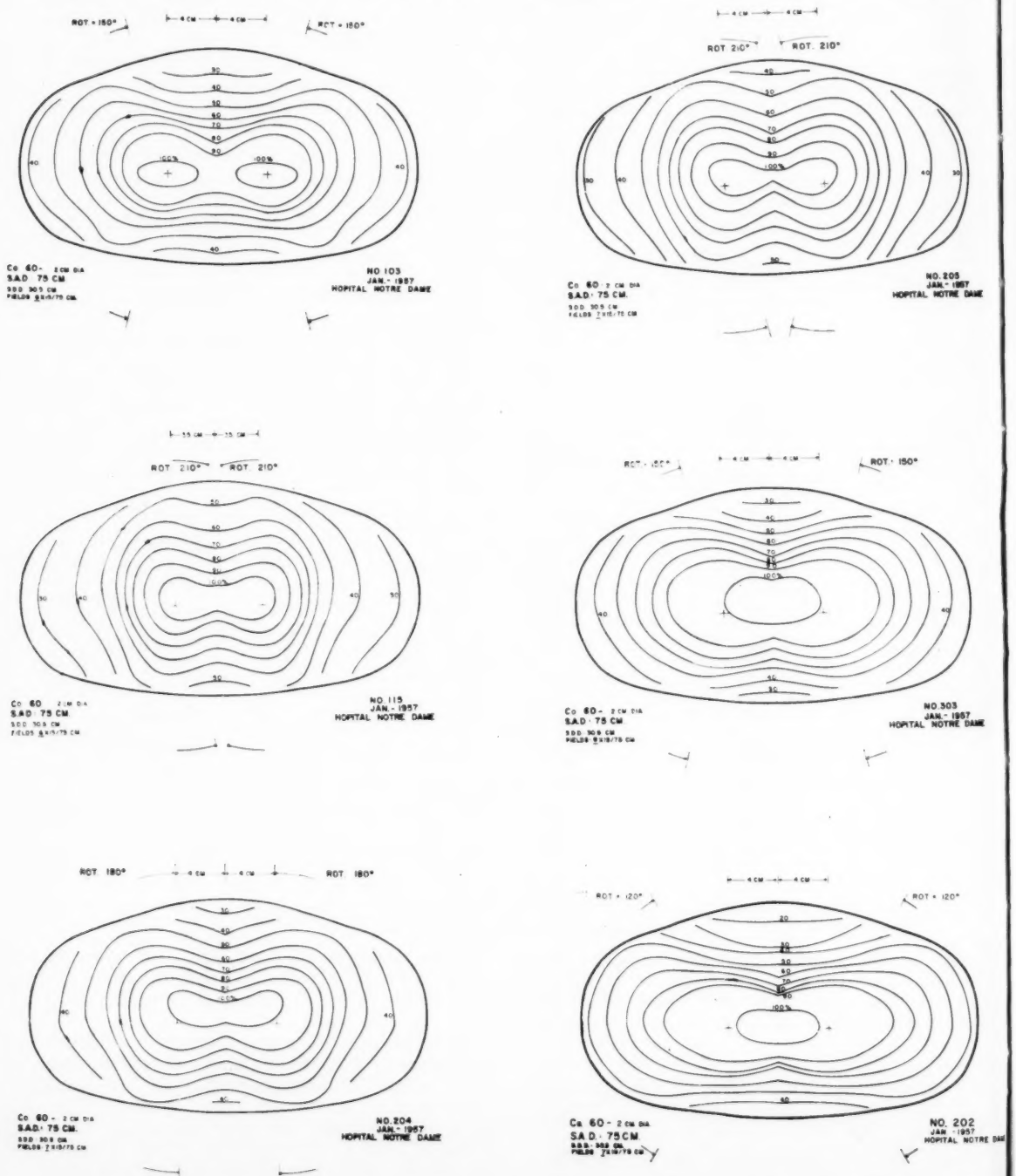

Fig. 1. — Various distributions of radiation obtained by combining rotations about two axes.

ate phantom. In this work we have used the film method for producing isodose curves. Kodak type M films were cut to the shape and size of a presswood phantom. The presswood phantom was made according to the anatomical data of Eycleshymer and Schoe-

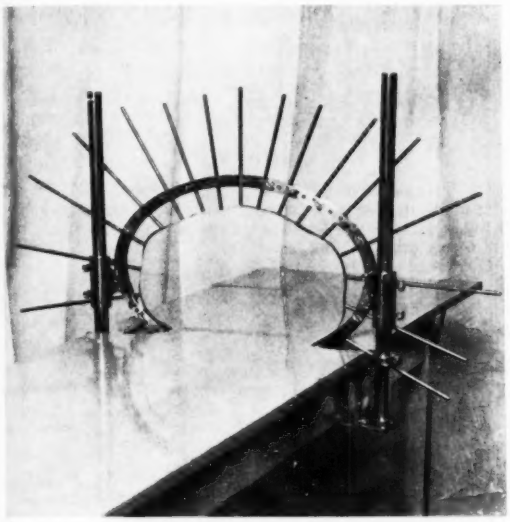

Fig. 2. — Contour Device.

maker[2]. Exposure time and speed of rotation of our Theratron Model B were adjusted in each case so that the maximum film density would be in the vicinity of 3. Films were developed by batches under standard conditions. Finally film densities were read at one centimeter intervals using a Welch Densitometer. Some of the isodose curves that we obtained in this way are shown in Fig. 1. Table I summarizes the data on isodose curves obtained. The integral dose has been calculated by measuring with a planimeter the isosurface and multiplying by a length and dose factor. In practice, the application of this technique is simple. For a given patient, the rotation and irradiation factors are chosen by applying the appropriate isodose curve for the size and shape of the lesion and its extensions in order to get the best dose distribution. A lateral film taken with the Theratron is the best way of determining whether the lesion is adequately centered. To visualize the position of the cervix on the film, a one centimeter diameter steel rod is placed in the vagina, the end being in contact with the cervix[5].

A contour of the patient in treatment position is made with the contour device shown in Fig. 2. The device is slightly modified from the original used by the Germans: it is composed of a rigid ovoid-shaped frame which is separable in two, an upper and a lower part; the frame holds 24 bearings placed 15 degrees apart. A one quarter inch magnetized steel rod is free to move back and forth in each bearing and also free to rotate plus or minus 5 degrees in one plane. Both movements can be locked by means of a single thumb-screw. The magnetization of the rods is sufficient to hold a thin steel tape from which the exact contour of the patient is drawn. From this contour the radii are measured for each side and the tumor-air ratio for each radius is taken from Johns' tables[3]. From these is calculated the fraction of the tumor exposure dose at both axes due to direct radiation. To this is added the contribution at the right axis due to rotation around the left axis and vice versa. The contribution at the axes, at the cervix or at any other point, is calculated using the Braestrup method of calculation[4].

The number and percentage of patients treated annually in our hospital by bi-axial rotation therapy, as compared to the total number of patients treated by radiation therapy, for cancer of the cervix, are given in Table II. The majority of patients in stage I and II treated by bi-axial rotation therapy had cancer of the cervical stump while the remaining patients received an exposure dose of the order of 2000 r. to 3000 r. as pre-radium therapy. The majority of patients tolerated

TABLE II

Number and Percentage of patients treated annually by Bi-Axial Rotation Therapy as compared to the total number of patients treated by radiation therapy, in carcinoma of the cervix, classified by stages. —

Stage / Year	I		II		III		IV	
1956	1/19	5%	1/13	8%	2/6	33%	5/14	36%
1957	1/34	3%	4/13	31%	9/14	64%	8/12	67%
1958	4/21	19%	0/9	0%	5/11	45%	6/11	55%

tissue exposure dose of the order of 6000 r. given in a period of 6 to 8 weeks. Some of these patients had also received a uterine radium application of 2000 to 3000 mgm/hr. This radium application might not be essential. However, when feasible, we consider that it is a sound practice, and possibly prevents recurrence of the lesion in the uterine cavity. This uterine radium application is also well tolerated. Despite the fact that these patients have received a large integral dose, serial hemograms have not shown any consistent changes during the period of treatment. Practically every patient treated suffered mild diarrhoea during the fourth week of treatment and sometimes earlier. This diarrhoea was controlled in every case by suitable medication.

The detailed clinical study of cases treated by this technique will be the subject of a forthcoming paper.

Summary

The radiation technique above described, permits the treatment with homogeneous dosage of ovoid-shaped lesions commonly found in advanced cases of cancer of the cervix. The technique has definite physical advantages over classical techniques using radium plus complementary external radiation therapy. It has been used in our department for 46 cases; the treatments were well tolerated and a tissue dose of the order of 6000 roentgens was given over a period of 6 to 8 weeks.

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FOUR CANADIANS WIN PICKER FOUNDATION AWARDS

Four Canadian scientists have been awarded grants for research by the James Picker Foundation. These grants, totalling $16,000 are intended to foster research in radiology in Canada.

The following awards were made for 1959-60, as announced today by the National Research Council of Canada, which administers the Canadian program of the James Picker Foundation:

DR. R. A. BEIQUE, Dept. of Radiology, Montreal General Hospital, Montreal — dichromography, a method for quantitative analysis of certain elements using their characteristic absorption edges;

DR. F. BOHATIRCHUK, Dept. of Anatomy, University of Ottawa — changes in ageing bone as revealed by ultra-soft X-rays;

DR. C. B. PEIRCE, Radiologist-in-Chief, Royal Victoria Hospital, and Chairman of the Dept. of Radiology, McGill University, Montreal — incident gonadal dose during medical radiologic procedures; and

DR. R. L. de C. H. SAUNDERS, Chairman of the Dept. of Anatomy, Dalhousie University, Halifax — microangiography by X-ray projection microscopy.